Abstract Submitted
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Multiscale Finite-Beta Gyrokinetics[1] W.W. LEE, E.A. STARTSEV, R. KOLESNIKOV, W.X. WANG, Princeton Plasma Physics Laboratory, Princeton, NJ 08543 — Finite-β effects on microinstabilities have been investigated by gyrokinetic particles codes using the new double split scheme [Startsev, Lee and Wang, manuscript in preparation]. The scheme requires that $F = (1+\psi)F_0 + \int dx_{||}\kappa_e \cdot (\nabla A_{||} \times \mathbf{b}_0) + \delta g$, so that a new full density gradient, which is set up by the fast electrons transverse to the direction of the full field, is consistent with the condition of $\mathbf{b}\cdot\nabla(F_0 + \int dx_{||}\kappa_e \cdot (\nabla A_{||} \times \mathbf{b}_0)) = 0$, where $\mathbf{b} = \mathbf{b}_0 + \delta\mathbf{B}/B_0$. Here ϕ is normalized by T_e/e, $A_{||}$ by cT_e/ec_s, F is the total distribution function, F_0 is the background distribution function, $\psi = \phi + \int(\partial A_{||}/\partial t)dx_{||}/c$, and ϕ and $A_{||}$ are the perturbed potentials. The finite-β effects on microinstabilities are found to be related to the multiscale equation of the form, $(\rho_s/\lambda_D)^2\left[\nabla^2\psi - \psi/\delta_e^2\right] = -4\pi q v\langle\delta(\mathbf{r})\rangle_\varphi$ where φ is the gyro angle based on the ion gyroradius, ρ_i, and δ_e is the electron skin depth, which can be an order of magnitude smaller in the tokamak core. To the lowest order, this equation gives rise to the shielding effect as $\psi = (q/r)(\rho_s/\lambda_D)exp(-r/\delta_e)$. Thus, we have the presence of two distinct spatial scales in the problem. A numerical scheme based on the concept of singular perturbation methods is used and the resulting finite-β effects on drift instabilities, ion temperature gradient drift modes and electron temperature gradient drift modes will be reported.

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